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# The role of Bright Light Therapy in psychiatric disorders: Review

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## ABSTRACT

**Introduction:** Bright Light Therapy (BLT) or phototherapy is a non-pharmacological intervention gaining traction for its potential efficacy in treating various psychiatric disorders. This review aims to explore BLT's therapeutic applications, mechanisms of action, and clinical implications across various psychiatric conditions. **State of Knowledge:** Historically, researchers have closely linked BLT to managing Seasonal Affective Disorder (SAD) by modulating circadian rhythms disrupted by seasonal changes in light exposure. Recent advancements have expanded its applicability to a broader spectrum of mood disorders, including non-seasonal depression, bipolar disorder, sleep disorders, and depression during pregnancy. Emerging research highlights BLT's potential in these areas, particularly given the concerns about teratogenic effects associated with antidepressant medications during pregnancy. **Summary:** BLT shows promising therapeutic potential for various psychiatric disorders. The reviewed studies suggest that BLT could serve as a valuable adjunctive or standalone treatment option in psychiatric practice. However, it is crucial to address the limitations of the existing literature, such as small sample sizes and heterogeneous study designs. Collaborative efforts among researchers, clinicians, and healthcare practitioners are essential to better understand BLT's efficacy, mechanisms of action, and optimal clinical applications. Future research should prioritize robust randomized controlled trials that include larger participant groups and consistent methodologies. Moreover, it is crucial to conduct longitudinal studies to investigate the sustained impact of BLT on psychiatric symptoms and patient outcomes, thereby clarifying its place in psychiatric treatment frameworks.

**Keywords:** Bright Light Therapy; Seasonal affective disorder; Depression Treatment; Sleep Disorders

## 1. INTRODUCTION

Bright light therapy (BLT), alternatively referred to as phototherapy or light therapy, is a non-pharmacological and non-psychological therapeutic intervention — a rarity in psychiatric practice — employed in treating a spectrum of disorders (Pail et al., 2011). Historically, researchers have closely linked BLT with managing mood disorders linked to seasonal changes, particularly seasonal affective disorder (SAD) (Rosenthal et al., 1984). However, emerging research has unveiled its potential applicability across a broader range of diagnoses, including non-seasonal depression, bipolar depression, depression during pregnancy, and sleep problems.

### Aim

This article endeavors to delve into the therapeutic capabilities of BLT across a spectrum of psychiatric conditions. By thoroughly examining existing studies and empirical, evidence-based research, this work aims to determine the effectiveness of BLT as a viable treatment option for various psychiatric disorders. By delving into the underlying mechanisms of action, exploring its clinical applications, and assessing the outcomes associated with BLT interventions, the aim is to furnish clinicians, researchers, and healthcare practitioners with invaluable insights into the multifaceted role of BLT in managing psychiatric disorders.

## 2. MATERIAL AND METHODS

The study implemented a comprehensive search strategy across various freely accessible databases, including PubMed, the National Library of Medicine, Clinical Trials, Google Scholar, and Cochrane. Keywords like "bright light therapy", "phototherapy", "mental health conditions", "depression", "bipolar disorder", and "seasonal affective disorder" were used to find relevant articles. The first screening process involved evaluating articles by their titles, followed by a second review of their abstracts. The study ultimately included only articles written in English or Polish that were directly relevant to the role of bright light therapy in treating psychiatric disorders.

### Mechanism of action

Bright light therapy (BLT) exerts its therapeutic effects through complex interactions within the neuroendocrine system, particularly involving the regulation of circadian rhythms and mood-related neurotransmitters. However, the precise biomolecular regulatory mechanisms governing its effects remain incompletely understood (Tao et al., 2020). Nevertheless, researchers can formulate hypotheses regarding the specific neurobiological mechanisms that underlie its therapeutic effects. The therapeutic effect of BLT primarily links to the eyes; when administered extraocularly, it does not exhibit significant antidepressant qualities (Pail et al., 2011). Retinal ganglion cells in the eyes, especially those containing melanopsin, perceive light and convert short-wavelength light signals into neural impulses.

Subsequently, these signals travel through the retinohypothalamic tract to the suprachiasmatic nucleus (SCN) situated in the anterior hypothalamus, recognized as the brain's primary circadian pacemaker (Pail et al., 2011). Melatonin, also known as N-acetyl-5-methoxytryptamine, plays a central role in the internal clock mechanisms. The pineal gland primarily secretes it, following a distinct circadian rhythm synchronized with the light-dark cycle — its levels peak at night and decrease during the day (Pandi-Perumal et al., 2008). Moreover, melatonin secretion also follows a seasonal pattern, with a more extended peak during winter and a shorter peak during summer (Rosenthal et al., 1984), (Morgan et al., 1994), reflecting its role in regulating seasonal variations in biological processes. As the SCN controls its secretion, it might represent another mechanism of action of BLT.

### Seasonal affective disorder

Seasonal affective disorder (SAD) is a condition that Rosenthal et al., (1984) first described. They defined it as recurrent depressive episodes typically occurring in autumn or winter, with remission observed in the spring or summer, persisting for at least two consecutive years, and not attributed to fluctuations in psychosocial factors (Rosenthal et al., 1984). Currently, the classification of Seasonal Affective Disorder (SAD) as a distinct psychiatric condition continues to provoke debate despite the longstanding observation of seasonal mood and behavioral fluctuations (Fonte and Coutinho, 2021). The latest version, the 11th edition of the International

Classification of Diseases and Related Health Problems (ICD-11), does not provide a direct classification for SAD, instead grouping it under recurrent depressive or bipolar disorders.

Likewise, the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) acknowledges seasonal mood variations only as a 'seasonal pattern' specifier, applicable to specific subsets of patients with bipolar and recurrent major depressive disorders (American Psychiatric Association, 2013). In Rosenthal et al., (1984) conducted the first controlled trial of a new treatment method, BLT. The following studies have concentrated on optimizing the treatment protocol. They determined that a dose of 10,000 lux for 30 minutes in the morning is the most efficacious (Terman et al., 1990; Terman et al., 1998; Terman and Terman, 2005; Eastman et al., 1998). Lower intensities would require longer durations to achieve similar effectiveness Eastman et al., (1998), potentially affecting compliance.

BLT, alongside conventional antidepressants, currently holds first-line status as a treatment for SAD Pjrek et al., (2004), although some recommendations caution that the evidence regarding its efficacy remains uncertain Depression in adults: Treatment and management, National Institute for Health and Care Excellence (NICE, 2022). However, according to the latest meta-analysis conducted by BLT showed significantly greater effectiveness in reducing depressive symptoms compared to placebo, with a standardized mean difference (SMD) of -0.37 (95% CI: -0.63 to -0.12) (Pjrek et al., 2020). Additionally, they derived a number needed to treat (NNT) of 4.86 from the secondary outcome, similar to the NNT for nonseasonal major depressive disorder treated with conventional antidepressants (Arroll et al., 2009; Gibbons et al., 2012).

It is noteworthy that the placebo-controlled studies had a short duration of treatment, up to 5 weeks Pjrek et al., (2020), so more extensive and longer placebo-controlled trials are necessary. Additionally, we would like to present two earlier meta-analyses. The first, conducted in 2005 by Golden et al., (2005) resulted in an SMD of 0.84 (95% CI: 0.60–1.08), while the second, published by Mårtensson et al., (2015), showed an SMD of -0.54 (95% CI: -0.95 to -0.13). Although the latest study reports a lower SMD, it includes more trials than the previous ones Pjrek et al., (2020) and still supports BLT as an effective treatment for SAD.

### Non-seasonal depression

Non-seasonal depression, often referred to as major depressive disorder (MDD), poses a considerable global health burden, affecting an estimated 350 million people worldwide. While pharmacotherapy and psychotherapy are conventional treatment approaches for MDD, researchers continuously explore alternative interventions to address the diverse needs of patients and improve treatment outcomes. One such intervention that has gained attention in recent years is BLT (Lam et al., 2016). BLT has demonstrated effectiveness in small-scale studies, both as a standalone therapy Pail et al., (2011) and as a supplement to antidepressant treatment (Terman et al., 1989). A 2016 meta-analysis conducted by Perera et al., (2016) examined BLT as a standalone therapy, revealing a favorable effect with a standardized mean difference in depression scores of -0.41 (95% CI -0.64 to -0.18).

However, the analysis also highlighted the poor quality of evidence due to a high risk of bias and inconsistency. The subsequent 2020 meta-analysis by Tao et al., (2020) included more randomized controlled trials (RCTs) compared to (Perera et al., 2016) (23 RCTs vs. 20 RCTs). Nonetheless, their results were similar, with the SMD of -0.405 (95% CI -0.597 to -0.212), and the quality of evidence remained low. The need for more well-designed placebo-controlled studies to confirm the efficacy of BLT persists. Additionally, further studies are needed to examine the effect of BLT as a complement to antidepressant therapy.

### Depression during pregnancy

Depression during pregnancy is a severe health concern, affecting approximately 11%-13% of pregnant women (Woody et al., 2017). However, treating depression during pregnancy presents a significant challenge due to concerns about the potential teratogenic effects of antidepressant medications (Byatt et al., 2013; Hanley and Oberlander, 2014). This controversy has prompted exploration into alternative treatment options, with bright light therapy (BLT) emerging as a promising candidate due to its low incidence of side effects and generally mild nature (Gdańska et al., 2019; Bais et al., 2020).

In Li et al., (2023) conducted a meta-analysis investigating this possibility. Their findings revealed that depressive symptoms improved significantly in the intervention group compared to the control group following light therapy, with a standardized mean difference (SMD) of 0.34 (95% CI: 0.08 to 0.61;  $p = 0.01$ ). However, given the restricted number of randomized controlled trial (RCT) designs and sample sizes included in this review, further research on light therapy for depression and sleep in perinatal women is warranted.

### Bipolar disorder

Promising results from studies on seasonal and non-seasonal affective disorders have spurred researchers to explore the potential of implementing BLT in treating depression in individuals with bipolar disorder (BD) (Geoffroy et al., 2018). Managing this condition poses a challenge for physicians, as only one-third of patients experience a reduction in their depressive symptoms with antimanic medications (Sachs et al., 2007). Furthermore, it is crucial to consider antidepressant-emergent mania when treating these patients (Fornaro et al., 2018). These findings prompted Dallaspezia and Benedetti, (2020) to conduct a meta-analysis on the efficacy of BLT in bipolar depression.

They found that BLT had a positive treatment effect in all the included studies Dallaspezia and Benedetti, (2020), specifically demonstrating efficacy in randomized controlled trials compared to placebo (Tseng et al., 2016). More investigation is warranted, mainly through RCTs employing standardized protocols. These studies can help identify markers of antidepressant response and subsequently customize the treatment procedure based on individual patient characteristics (Dallaspezia and Benedetti, 2020). BLT can also serve as an augmentation treatment for bipolar depression, as demonstrated by its effectiveness in a meta-analysis conducted by (Tseng et al., 2016). Similarly, a meta-analysis by Hirakawa et al., (2020) demonstrated its effectiveness as a treatment for bipolar depression.

### Sleep Disorders

Indeed, light plays a crucial role in regulating our sleep and wakefulness cycles (Cajochen, 2007). Therefore, BLT emerges as a natural and straightforward treatment option for sleep disorders. However, research into the effectiveness of light therapy has produced inconclusive results, potentially attributed to the wide range of sleep problems targeted by researchers employing light therapy. Consequently, Van-Maanen et al., (2016) conducted a meta-analysis focusing on specific types of sleep problems. Their findings revealed that BLT was effective in treating circadian rhythm sleep disorders Van-Maanen et al., (2016), insomnia, and sleep problems associated with Alzheimer's disease (AD) or dementia. Roccaro and Smirni, (2020) further investigated the issue of sleep problems in AD, concluding that BLT holds significant promise as a potential treatment for this crucial problem. Their findings underscored the necessity for more standardized research in this area.

### Side effects

BLT is a promising therapeutic strategy because it exhibits minimal and generally mild side effects, especially when compared to conventional antidepressants (Khawam et al., 2006). The predominant adverse effects include headache, migraine, eyestrain, nausea, and agitation (Pail et al., 2011). These side effects typically resolve spontaneously or following a reduction in dosage (Khawam et al., 2006). When using BLT to treat bipolar depression, it is essential to consider the risk of manic switch (Fornaro et al., 2018). However, the previously cited meta-analysis found this risk to be low Dallaspezia and Benedetti, (2020) and similar to the placebo group (Hirakawa et al., 2020).

## 4. DISCUSSION

Bright light therapy (BLT) emerges as a promising therapeutic intervention for various psychiatric disorders, showing potential efficacy in alleviating symptoms associated with conditions such as seasonal affective disorder (SAD), non-seasonal depression, bipolar depression, depression during pregnancy, and sleep disorders. The reviewed studies demonstrate encouraging outcomes, suggesting that BLT could be a valuable adjunctive or standalone treatment option in psychiatric practice. However, it is crucial to acknowledge the limitations of the existing literature (Pail et al., 2011; Tao et al., 2020; Arroll et al., 2009; Pjrek et al., 2020). A significant limitation is the relatively small number of participants in many reviewed studies. Small sample sizes may influence the generalizability and statistical power of the findings, potentially constraining the robustness of the conclusions drawn.

Additionally, the heterogeneity in study designs, participant characteristics, and outcome measures across the literature complicates the synthesis of results and makes it challenging to establish definitive conclusions regarding the efficacy of BLT across different psychiatric disorders. Moreover, while BLT exhibits promise as a non-pharmacological intervention, its mechanisms of action and optimal treatment parameters are still not fully understood (Tao et al., 2020). Future research should aim to address these knowledge gaps by conducting meticulously planned randomized controlled trials with increased sample sizes and standardized protocols.

Moreover, longitudinal studies exploring the long-term effects of BLT on psychiatric symptoms and patient outcomes would provide valuable insights into its sustained therapeutic benefits.

## 5. CONCLUSION

The potential of BLT as a therapeutic intervention for psychiatric disorders is promising, yet further research is crucial to overcome the limitations observed in existing literature, particularly regarding sample size and study design. Collaborative efforts among researchers, clinicians, and healthcare practitioners are essential for advancing our understanding of BLT's efficacy, mechanisms of action, and optimal clinical applications in managing psychiatric disorders.

### Authors Contributions

Aleksy Bizan and Agata Mazur: Conceptualization

Sylwia Mazur and Magdalena Madera: Methodology

Aleksy Bizan: Software

Magdalena Madera, Emilia Nagórska and Krzysztof Marcinkowski: Check

Karolina Strus: Formal analysis

Karolina Strus and Aleksandra Kublińska: Investigation

Roksana Zdunek, Sylwia Mazur: Resources

Roksana Zdunek and Natalia Dąbrowska: Data curation

Agata Mazur, Aleksandra Kublińska and Emilia Nagórska: Writing - rough preparation

Aleksy Bizan, Krzysztof Marcinkowski and Natalia Dąbrowska: Writing - review and editing

Roksana Zdunek: Supervision

Agata Mazur: Project administration

All authors have read and agreed with the published version of the manuscript.

### Informed consent

Not applicable

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### Conflict of interest

The authors declare that there is no conflict of interests.

### Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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